

## WHAT IS CLAIMED IS:

## 1. A fuel cell comprising:

5 at least one unit cell including a first separator which is disposed on one side of a membrane-electrode assembly, and which includes a first concave groove which constitutes a first gas passage, and a first convex rib whose rear surface constitutes a first refrigerant passage, and on which a first gas cross groove is formed; and a second separator which is disposed on the other side of the membrane-electrode assembly, and which includes a second concave groove which constitutes a second gas passage, and a second convex rib whose rear surface constitutes a second refrigerant passage, and on which a second gas cross groove is formed,

10 wherein an integral refrigerant passage whose cross sectional area in a direction in which the integral refrigerant passage extends is equal to or larger than that of the first refrigerant passage and that of the second refrigerant passage is formed by combining the first refrigerant passage and the second refrigerant passage in a cell stacked direction when a plurality of the first separators and a plurality of the second separators are stacked.

2. The fuel cell according to claim 1, wherein the first concave groove and the first convex rib are provided in plurality, and are positioned in parallel with each other in a direction in which the first concave groove and the first convex rib extend, and the first gas cross groove is formed in a direction perpendicular to the direction in which the first convex rib extends, and cross-links at least two of the first concave grooves; and the second concave groove and the second convex rib are provided in plurality, and are positioned in parallel with each other in a direction in which the second concave groove and the second convex rib extend, and the second gas cross groove is formed in a direction perpendicular to the direction in which the second convex rib extends, and cross-links at least two of the second concave grooves.

3. The fuel cell according to claim 1, wherein the first gas cross groove and the second gas cross groove are provided in plurality, and are alternately positioned in the direction in which the integral refrigerant passage extends, and intervals, each of which is between the first gas cross groove and the second gas cross groove that are adjacent to each other, are substantially the same.

4. The fuel cell according to claim 1, wherein the first separator is a metal separator, and the first concave groove, the first convex rib, and the first gas cross groove are formed by press molding; and the second separator is a metal separator, and the second concave groove, the second convex rib, and the second gas cross groove are formed by press

5 molding.

5. The fuel cell according to claim 1, wherein a depth of the first gas cross groove is equal to a height of the first concave rib, and a depth of the second gas cross groove is equal to a height of the second concave rib.

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6. The fuel cell according to claim 1, wherein a concave surface of the first convex rib and a concave surface of the second convex rib contact the membrane-electrode assembly, and each of a contacting area between the first convex rib and the membrane-electrode assembly and a contacting area between the second convex rib and the membrane-electrode assembly is 20 % to 40 % of a surface area of the membrane-electrode assembly.

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7. The fuel cell according to claim 1, wherein a width of each of the first convex rib and the second convex rib is 0.5 mm to 1.5 mm, and a height of each of the first convex rib and the second convex rib is 0.3 mm to 0.6 mm.

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8. The fuel cell according to claim 1, wherein each of a pitch between the first gas cross grooves and a pitch between the second gas cross grooves is 2 mm to 50 mm, and each of a length of the first gas cross groove in a direction in which the first convex rib extends and a length of the second gas cross groove in a direction in which the second convex rib extends is 0.5 mm to 3 mm.

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9. The fuel cell according to claim 1, wherein a width of each of the first concave groove and the second concave groove is 0.5 mm to 3 mm.

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10. A fuel cell comprising:

at least one unit cell including a first separator which is disposed on one side of a membrane-electrode assembly, and which includes a first concave groove which constitutes a first gas passage, and a first convex rib whose rear surface constitutes a first refrigerant passage, and on which a first gas cross groove is formed; and a second separator

which is disposed on the other side of the membrane-electrode assembly, and which includes a second concave groove which constitutes a second gas passage, and a second convex rib whose rear surface constitutes a second refrigerant passage, and on which a second gas cross groove is formed,

5       wherein in an integral refrigerant passage formed by combining the first refrigerant passage and the second refrigerant passage in a cell stacked direction when a plurality of the first separators and a plurality of the second separators are stacked, a position of the first gas cross groove and a position of the second gas cross groove are deviated from each other in a direction in which the integral refrigerant passage extends.

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11. The fuel cell according to claim 10, wherein the first concave groove and the first convex rib are provided in plurality, and are positioned in parallel with each other in a direction in which the first concave groove and the first convex rib extend, and the first gas cross groove is formed in a direction perpendicular to the direction in which the first

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convex rib extends, and cross-links at least two of the first concave grooves; and the second concave groove and the second convex rib are provided in plurality, and are positioned in parallel with each other in a direction in which the second concave groove and the second convex rib extend, and the second gas cross groove is formed in a direction perpendicular to the direction in which the second convex rib extends, and cross-links at

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least two of the second concave grooves.

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12. The fuel cell according to claim 10, wherein the first gas cross groove and the second gas cross groove are provided in plurality, and are alternately positioned in the direction in which the integral refrigerant passage extends, and intervals, each of which is between the first gas cross groove and the second gas cross groove that are adjacent to each other, are substantially the same.

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13. The fuel cell according to claim 10, wherein the first separator is a metal separator, and the first concave groove, the first convex rib, and the first gas cross groove are formed by press molding; and the second separator is a metal separator, and the second concave groove, the second convex rib, and the second gas cross groove are formed by press molding.

14. The fuel cell according to claim 10, wherein a depth of the first gas cross groove is

equal to a height of the first concave rib, and a depth of the second gas cross groove is equal to a height of the second concave rib.

15. The fuel cell according to claim 10, wherein the first convex rib and the second convex  
5 rib contact the membrane-electrode assembly, and each of a contacting area between the first convex rib and the membrane-electrode assembly and a contacting area between the second convex rib and the membrane-electrode assembly is 20 % to 40 % of a surface area of the membrane-electrode assembly.
- 10 16. The fuel cell according to claim 10, wherein a width of each of the first convex rib and the second convex rib is 0.5 mm to 1.5 mm, and a height of each of the first convex rib and the second convex rib is 0.3 mm to 0.6 mm.
- 15 17. The fuel cell according to claim 10, wherein each of a pitch between the first gas cross grooves and a pitch between the second gas cross grooves is 2 mm to 50 mm, and each of a length of the first gas cross groove in a direction in which the first convex rib extends and a length of the second gas cross groove in a direction in which the second convex rib extends is 0.5 mm to 3 mm.
- 20 18. The fuel cell according to claim 10, wherein a width of each of the first concave groove and the second concave groove is 0.5 mm to 3 mm.